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Hydropeaking attenuation in revitalised rivers

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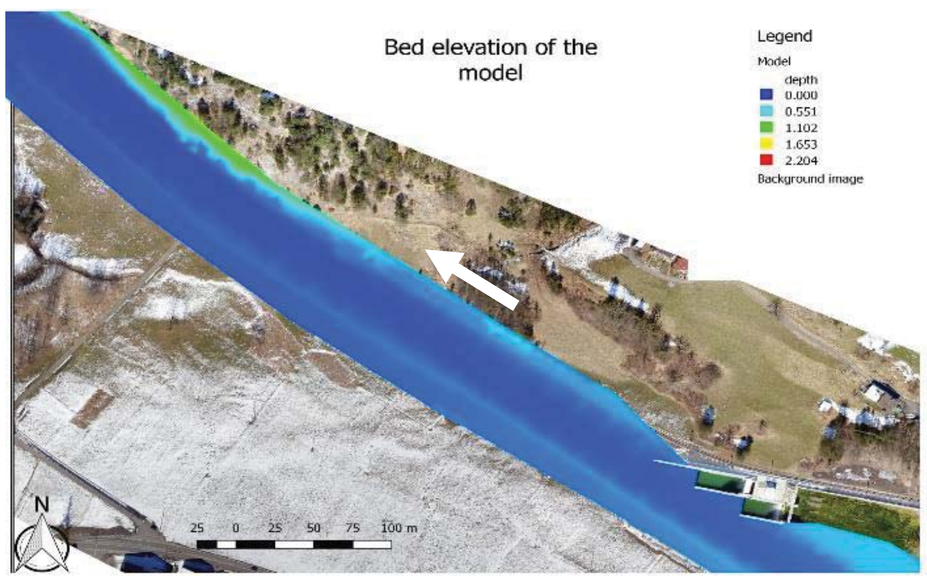
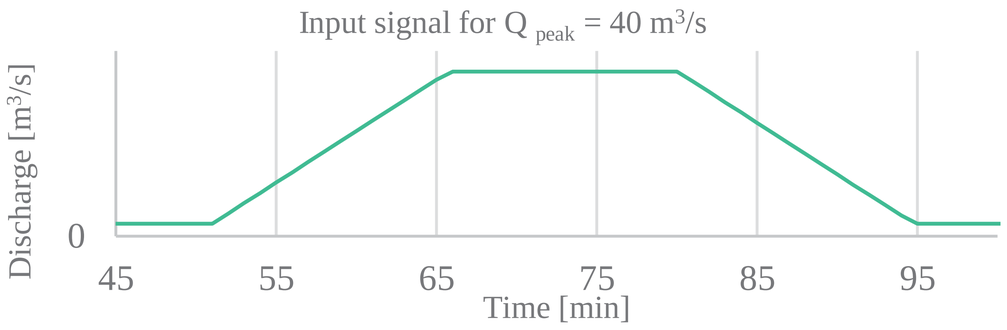
INTRODUCTION AND OBJECTIFS

Power plants operate their turbine to match the peaks in electricity demand. This leads to strongly unsteady flow regimes downstream of the power plants outlet into the river. From an ecological point of view, those sudden starting and stopping of turbines, called hydropeaking, are unacceptable. A more restrictive operating of the turbines is not practicable therefore, to counteract these unfavourable effect, two types of mitigation measures have been found to be effective; structural or morphological measures, i.e. a compensation basin or modifications in the river morphology. The second is analysed in the work to assess the effect of various features inside a channel on hydropeaking rates. The tested case are then compared to a real channel reach with a groinfield.

MODEL - HASLIAARE

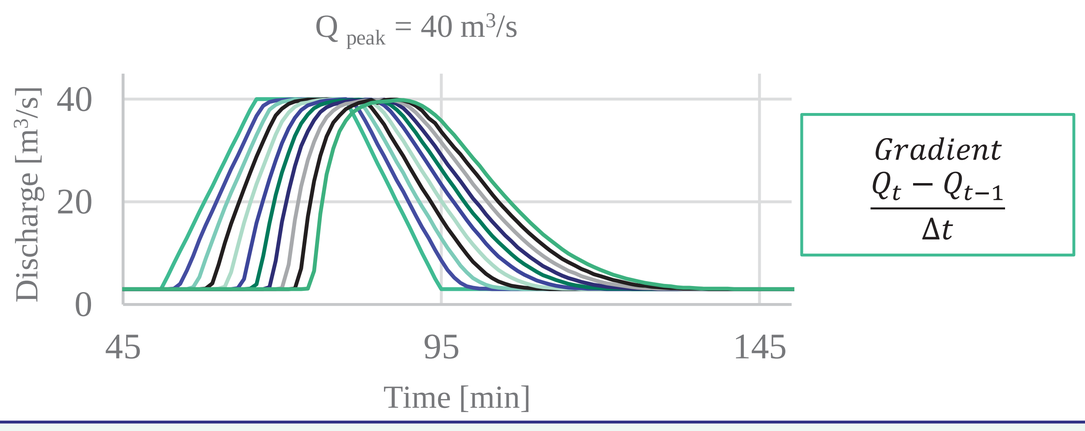


HYDROLOGY

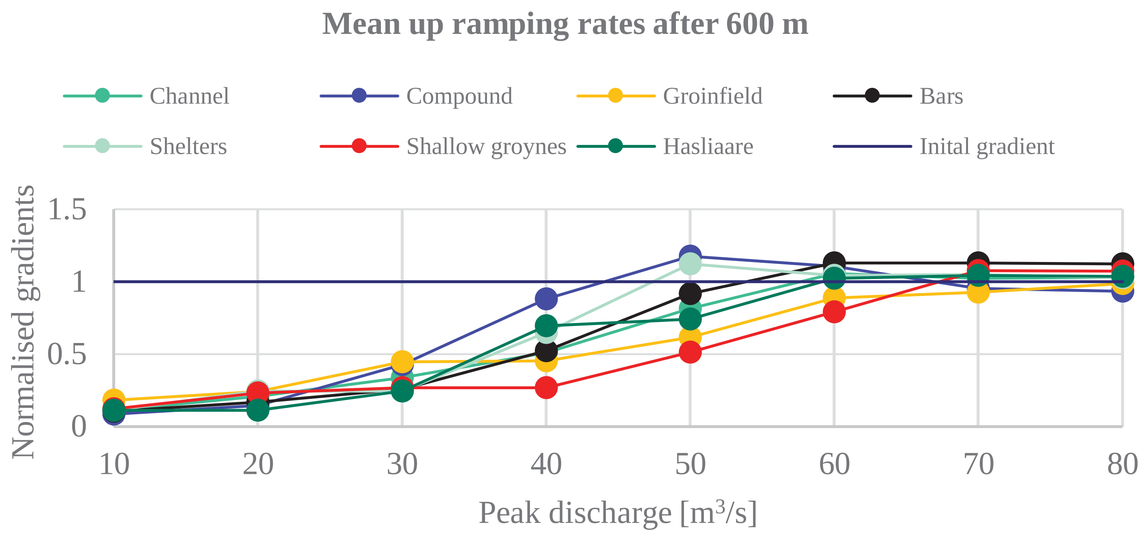


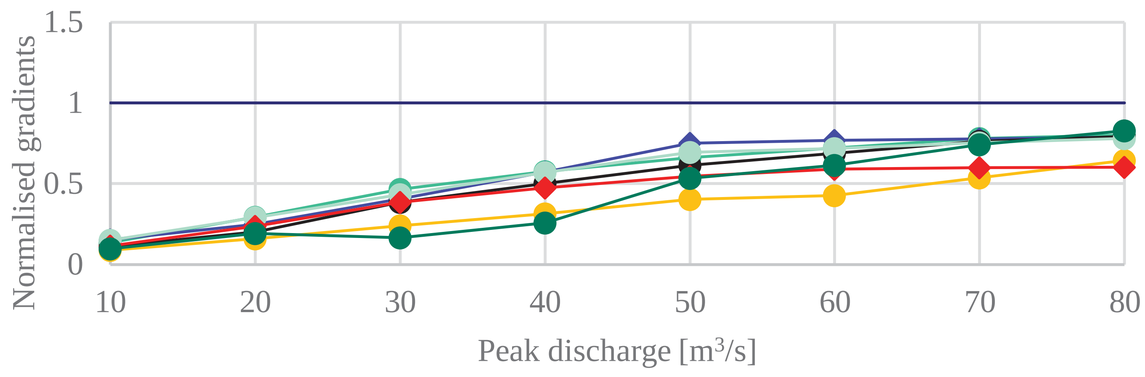
- 6 morphologies based on geometry of groinfield in Innertkirchen
  - Trapezoidal channel
  - Compound channel
  - Groinfield
  - Shallow groynes
  - Fish shelters
  - Hasliaare (only 600 m long)
- Base flow of 3 m³/s
- 8 peak discharges [10, 20, 30, 40, 50, 60, 70, 80 m³/s]
- 8 simulations per morphology
- Initial gradient : 2.5 $m^3 s^{-1} min^{-1}$

HYDROGRAPH EVOLUTION EVERY 200 M

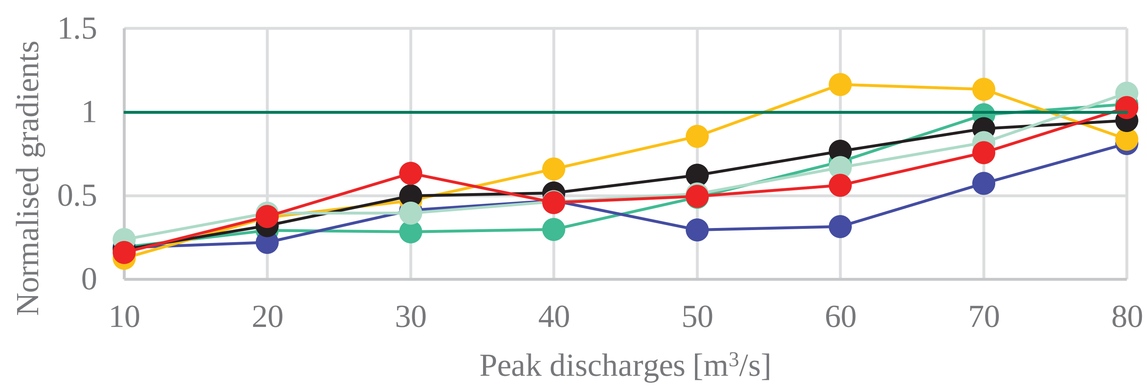


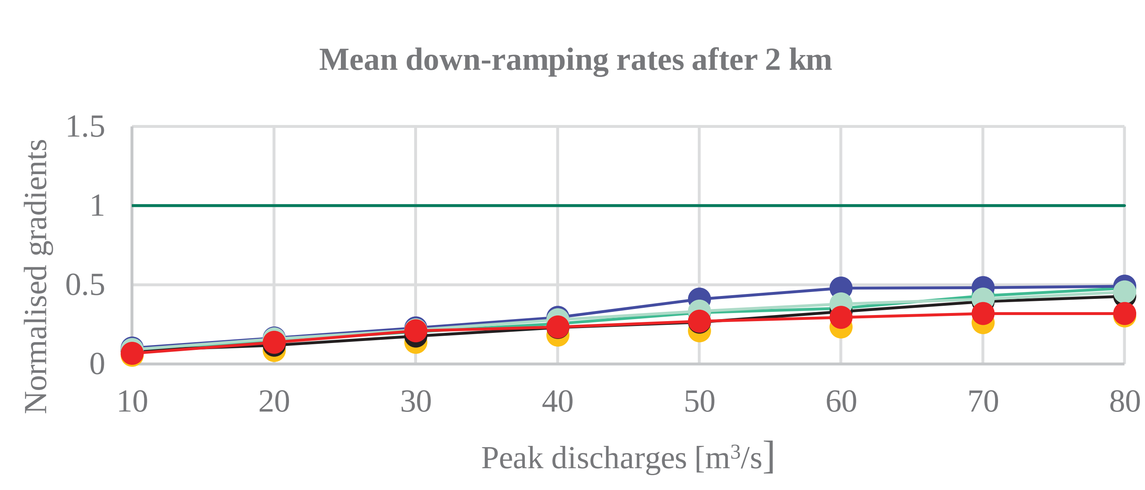
RESULTS AFTER 600 M (WITH HASLIAARE)





RESULTS AFTER 2 KM (WITHOUT HASLIAARE)





CONCLUSION

Different morphological features present different advantages, and all of them attenuate down-ramping rates, after 2 km all show at least a 50 % attenuation capacity for even higher peak discharges. The smaller the peak discharge the stronger the down-ramping rate attenuation, this is not as clear cut for up-ramping rates. Therefore the assessment of the most efficient morphology for hydropeaking attenuation is based on its capacity to attenuation positive gradients. The groinfield even though it amplifies the gradients with peak discharges which partially submerge the groynes, i.e. between 60 and 70 m³/s, attenuates best the highest tested peak discharge. The compound channel is overall best, but the implementation of flood plans has too a big of an impact on flood risk. Finally, with groynes being not as pejorative for the flood risk, is found to be the best possible solution for a morphological hydropeaking mitigation feature.